

## DESCRIPTION

## POLYESTER RESIN COMPOSITION AND OPTICAL MATERIAL

## TECHNICAL FIELD

5 The present invention relates to a polyester and polycarbonate resin composition which can be suitably used for optical materials. More specifically, the present invention relates to a resin composition which is low in birefringence and superior in transparency, mechanical strength and dimension 10 stability and has a good balance between a refractive index and an Abbe number, high heat resistance and good fluidity, and which can be suitably used for optical materials such as a camera lens, an eyeglass lens, an optical disk, an optical fiber and an optical sheet.

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## BACKGROUND ART

Hitherto, resins which are transparent and have excellent mechanical properties are often used as an optical material. For example, poly(methyl methacrylate) (hereinafter, 20 abbreviated as PMMA), polycarbonate (hereinafter, abbreviated as PC), and amorphous polyolefin (hereinafter, abbreviated as APO) are used as the optical materials such as a compact disk, a laser disk, a projection lens, a f-theta lens, a photograph lens, a viewfinder lens, an optical pickup lens and a digital 25 camera lens, and they are used for transparent parts and reflection material of an automobile. PMMA is often used because of excellent transparency and small optical anisotropy, but it has high hygroscopicity, and deformations such as camber tend to appear after molding and morphological stability is low.

30 On the other hand, PC has high heat resistance and excellent transparency, but it has a problem that its fluidity is poor and this causes the birefringence of a shaped article to increase, and therefore it cannot be said that it is adequately satisfactory as an optical material. And, APO has high heat resistance and 35 excellent transparency, but it is low in fluidity and apt to

color in molding. And, since APO cannot attain sufficient adhesion without being subjected to a step of pretreatment such as plasma treatment in bonding a vapor deposition film or a hard-coated film to APO, it cannot be said that it is adequately 5 satisfactory as an optical material.

Further, in recent years, an optical disk and a digital 10 videodisk, which record and playback information such as voices, images and characters using laser light have been sharply developed, and a substrate material having higher-performance optical properties is desired. Since photograph lenses of 15 miniature cameras used for a digital camera or a mobile phone are increasingly downsized and further image-recognition systems such as CCD and CMOS trend toward miniaturization and high precision, a resin material having less optical anisotropy is desired.

And, the endurance in use in more severe environments is required. For example, it was requirements in the past that 20 transparency was not impaired under the conditions of 65°C in temperature and 80% in humidity, but recently it is required that the transparency is not impaired and the deformation of a lens surface is small under the conditions of 85°C in temperature and 90% in humidity.

As polyester polymer or polyester copolymer, there is proposed as an optical material a polymer which is obtained from 25 aromatic dicarboxylic acid and 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorenes in Japanese Patent No. 2843215 and No. 2843214. And, a polymer which is obtained from alicyclic dicarboxylic acid and 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorenes is proposed in 30 Japanese Patent No. 3331121, Japanese Published Application H11-60706, and Japanese Published Application 2000-319366. These polyester copolymers are useful as an optical material because of a high refractive index, a low birefringence, high heat resistance and transparency, but they are not necessarily 35 satisfactory since expensive raw materials are used or the heat

resistance is insufficient.

As a resin composition formed by blending a polyester polymer with PC, there is proposed, for example, a resin composition obtained by blending polyester obtainable from an aromatic dicarboxylic acid with polycarbonate obtainable from an aromatic dihydroxyl compound in Japanese Published Application 2002-265771, but there is no description on applications to optical uses, for example, optical lenses such as a camera lens and an eyeglass lens, and optical films.

10 In Japanese Patent No. 3023279, there is proposed a resin composition as an optical material, which is obtained by blending a polymer obtainable from aromatic dicarboxylic acid and 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorenes with PC. This resin composition is useful as an optical material because of 15 high heat resistance, a high refractive index and a low birefringence, but a material, which does not lose the transparency and has the small deformation of a lens surface under the conditions of 85°C in temperature and 90% in humidity, and has the less coloring in molding, the good balance between 20 a refractive index and an Abbe number and the low birefringence while maintaining the heat resistance, is desired.

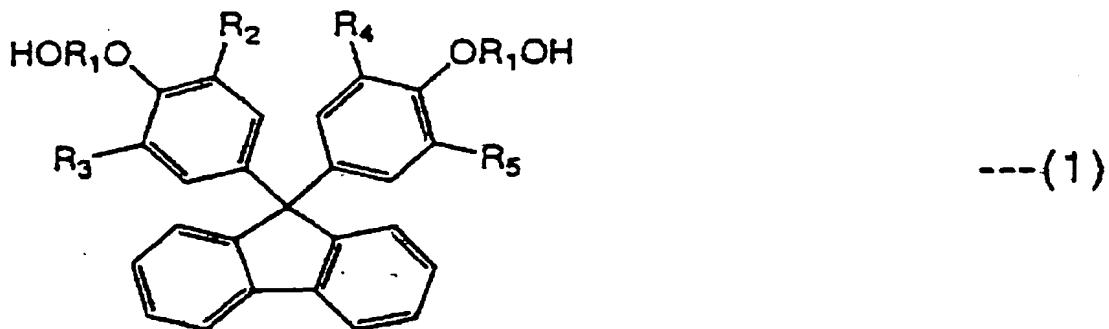
#### SUMMARY OF THE INVENTION

It is an object of the present invention to provide a resin 25 which resolves the above-mentioned problems, and is low in birefringence and superior in transparency, mechanical strength and dimension stability, and has a good balance between a refractive index and an Abbe number, high heat resistance and good fluidity, and which can be suitably used for optical 30 materials such as a camera lens, an eyeglass lens, an optical disk, an optical fiber and an optical sheet.

The present inventor made various investigations in order 35 to resolve the above-mentioned issues, and consequently found that the above issues can be resolved by employing a resin composition obtained by blending a polyester polymer obtainable

from a dicarboxylic acid compound and a dihydroxyl compound, in which the dicarboxylic acid compound comprises an alicyclic dicarboxylic acid and/or an ester-forming derivative thereof and the dihydroxyl compound comprises a specific dihydroxyl compound, with a polycarbonate. These findings have now led to completion of the present invention.

That is, the present invention is characterized by being a resin composition obtained by blending a polyester polymer obtainable from a dicarboxylic acid compound and a dihydroxyl compound with a polycarbonate, wherein the dicarboxylic acid compound comprises an alicyclic dicarboxylic acid and/or an ester-forming derivative thereof and the dihydroxyl compound comprises a compound expressed by the formula (1):



15 wherein  $R_1$  is an alkylene group having 2 to 4 carbon atoms, and  $R_2$ ,  $R_3$ ,  $R_4$ , and  $R_5$  represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 4 carbon atoms, respectively, and may be identical to or different from one another.

Further, the resin composition of the present invention  
20 is preferably obtained by blending a polyester polymer obtainable  
from a dicarboxylic acid compound and a dihydroxyl compound with  
polycarbonate, wherein the dicarboxylic acid compound comprises  
an alicyclic dicarboxylic acid and/or an ester-forming  
derivative thereof and the dihydroxyl compound comprises a  
25 compound expressed by the formula (1), and a blending ratio of  
the polyester polymer and the polycarbonate is in a range from  
5 : 95 to 95 : 5 by weight.

And, the alicyclic dicarboxylic acid is preferably at least one species of compounds selected from cyclohexanedicarboxylic acid, decalindicarboxylic acid, norbornanedicarboxylic acid, adamantanedicarboxylic acid, and tricyclodecendicarboxylic acid.

In accordance with the present invention, it becomes possible to provide a material which is low in birefringence and superior in transparency, mechanical strength and dimension stability, and has high heat resistance, good fluidity and a good balance between a refractive index and an Abbe number, and therefore has a good balance between the moldability and the optical properties, and it becomes possible to provide a resin which can be suitably used for optical materials such as a camera lens, an eyeglass lens, an optical disk, an optical fiber and an optical sheet.

#### BRIEF DESCRIPTION OF THE DRAWINGS

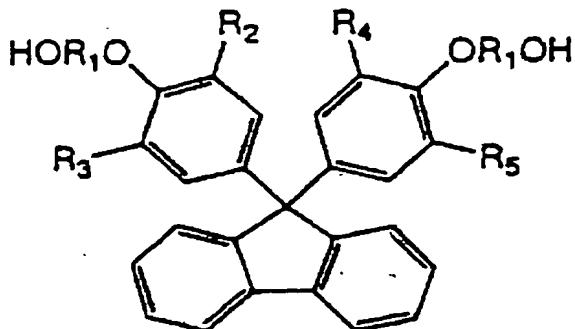
Fig. 1 shows a DSC measurement chart of a resin composition of Example 1.

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#### DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, the embodiments of the present invention will be described.

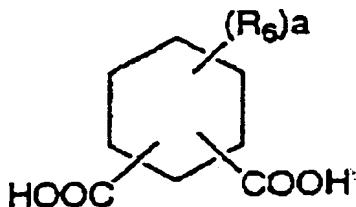
A polyester resin composition of the present invention is a resin composition obtained by blending a polyester polymer obtainable from a dicarboxylic acid compound and a dihydroxyl compound with a polycarbonate, wherein the dicarboxylic acid compound comprises an alicyclic dicarboxylic acid and/or an ester-forming derivative thereof and the dihydroxyl compound comprises a compound expressed by the formula (1):



---(1)

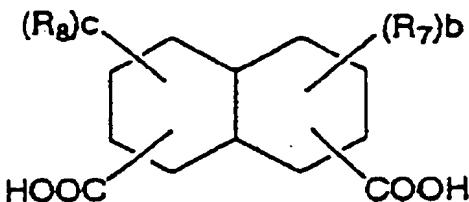
wherein R<sub>1</sub> is an alkylene group having 2 to 4 carbon atoms, and R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, and R<sub>5</sub> represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 4 carbon atoms, respectively, 5 and may be identical to or different from one another.

Examples of the alicyclic dicarboxylic acids made available for the polyester polymer of the present invention include monocyclic alicyclic dicarboxylic acids such as cyclohexanedicarboxylic acid expressed by the following formula 10 (2) and polycyclic alicyclic dicarboxylic acids such as decalin dicarboxylic acids expressed by the following formula (3) and (4); norbornanedicarboxylic acids expressed by the following formula (5) and (6); adamantanedicarboxylic acids expressed by the following formula (7) and (8); and 15 tricyclodecendicarboxylic acids expressed by the following formula (9), (10) and (11):



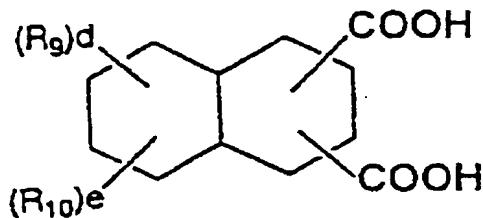
---(2)

wherein R<sub>6</sub> represents hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, 20 and may be identical to or different from one another, and a is a natural number of 1 to 3;



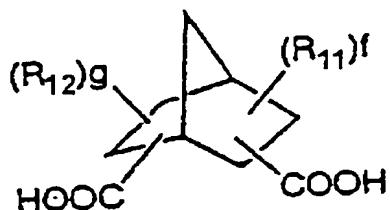
---(3)

wherein R<sub>7</sub> and R<sub>8</sub> represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from each other, and b and  
 5 c are a natural number of 1 to 7;



---(4)

wherein R<sub>9</sub> and R<sub>10</sub> represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from each other, and d and  
 10 e are a natural number of 1 to 7;

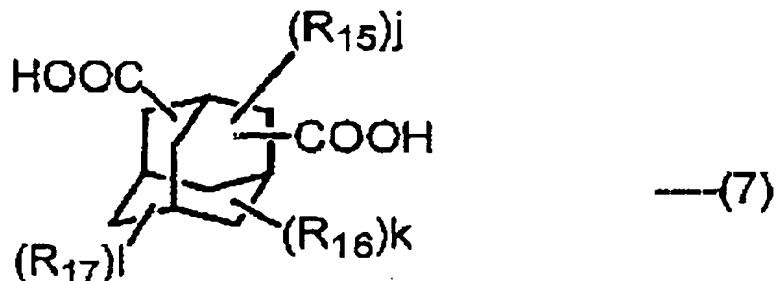


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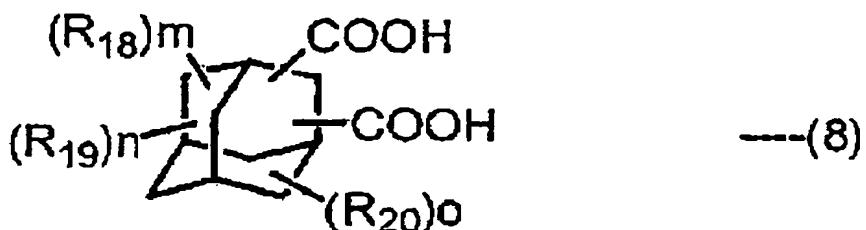
wherein R<sub>11</sub> and R<sub>12</sub> represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from each  
 15 other, and f and g are a natural number of 1 to 7;



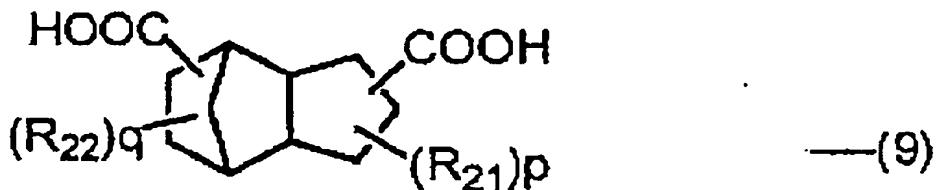
wherein  $R_{13}$  and  $R_{14}$  represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from each 5 other, and  $h$  and  $i$  are a natural number of 1 to 7;



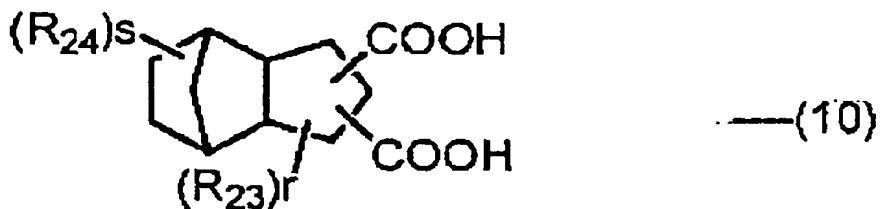
wherein  $R_{15}$ ,  $R_{16}$  and  $R_{17}$  represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from one 10 another, and  $j$  and  $k$  are a natural number of 1 to 8 and  $l$  is a natural number of 1 to 9;



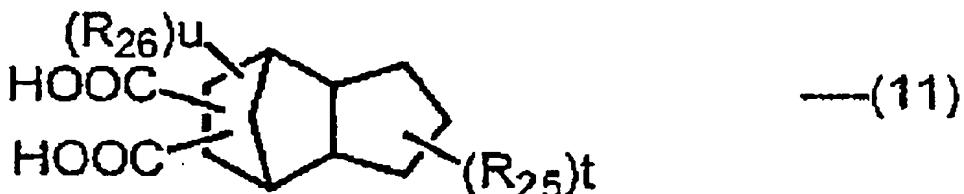
wherein  $R_{18}$ ,  $R_{19}$  and  $R_{20}$  represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, 15 respectively, and may be identical to or different from one another, and  $m$  and  $n$  are a natural number of 1 to 8 and  $o$  is a natural number of 1 to 9;



wherein R<sub>21</sub> and R<sub>22</sub> represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from each 5 other, and p and q are a natural number of 1 to 7;



wherein R<sub>23</sub> and R<sub>24</sub> represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from each 10 other, and r and s are a natural number of 1 to 7;



wherein R<sub>25</sub> and R<sub>26</sub> represent hydrogen, or an alkyl group, an aryl group or an aralkyl group having 1 to 7 carbon atoms, respectively, and may be identical to or different from each 15 other, and t and u are a natural number of 1 to 8.

Examples of ester-forming derivatives of these alicyclic dicarboxylic acid include ester-forming derivatives of dicarboxylic acid commonly used for polyester and include, for example, alkyl esters such as dimethyl ester, diethyl ester and 20 the like.

These alicyclic dicarboxylic acids or ester-forming derivatives thereof may be used alone or in combination of two or more species.

Among these alicyclic dicarboxylic acids,  
5 1,4-cyclohexanedicarboxylic acid,  
1,4-cyclohexanedicarboxylic acid dimethyl ester,  
2,6-decalindicarboxylic acid, and 2,6-decadecalindicarboxylic acid dimethyl ester are preferred in point of ease of synthesis,  
10 the moldability and optical properties but are not limited to these dicarboxylic acids.

1,4-Cycloddicarboxylic acid has isomers of trans/cis, but the ratio between trans and cis isomers is not particularly limited. The trans isomer has a melting point of about 312°C which is higher than that of the cis isomer. The cis isomer  
15 has a melting point of about 150°C. When the polyester of the present invention is polymerized by melt-polymerization, it is polymerized at elevated temperatures (230 to 300°C). During this polymerization, transition between trans and cis isomers occurs, and the ratio between trans and cis isomers of the resin  
20 ultimately obtained falls within a range of 50/50 to 70/30 when the ratio between trans and cis at the stage of monomer, measured by <sup>1</sup>H-NMR, is 90/10 to 10/90.

In the present invention, alicyclic dicarboxylic acid or an ester-forming derivative thereof may be contained in  
25 arbitrary amount of 1 to 100 mol% with respect to 100 mol% of the total dicarboxylic acid components, but when it is used together with aliphatic dicarboxylic acid as another dicarboxylic acid, its content is preferably 50 mol% or less with respect to 100 mol% of the total dicarboxylic acid components  
30 in order to enhance heat resistance more. When it is used together with monocyclic aromatic dicarboxylic acid as another dicarboxylic acid, its content is preferably 80 mol% or less in order to reduce the birefringence. When it is used together with polycyclic aromatic dicarboxylic acid or biphenyl  
35 dicarboxylic acid as another dicarboxylic acid, its content

is preferably 50 mol% or less in order to reduce the birefringence.

Examples of dicarboxylic acids used as another component in the present invention include aliphatic dicarboxylic acids such as malonic acid, succinic acid, glutaric acid, adipic acid, 5 pimelic acid, suberic acid, azelaic acid, methylmalonic acid, ethylmalonic acid and the like; monocyclic aromatic dicarboxylic acids such as terephthalic acid, isophthalic acid and the like; naphthalenedicarboxylic acids such as 2,6-naphthalenedicarboxylic acid, 10 1,8-naphthalenedicarboxylic acid and the like; polycyclic aromatic dicarboxylic acids such as anthracenedicarboxylic acid, phenanthrenedicarboxylic acid and the like; and biphenyldicarboxylic acids such as 2,2'-biphenyldicarboxylic acid and the like.

15 In the present invention, examples of dihydroxyl compounds expressed by the formula (1) include  
 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3-methylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3,5-dimethylphenyl]fluorene,  
 20 9,9-bis[4-(2-hydroxyethoxy)-3-ethylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3,5-diethylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3-propylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3,5-dipropylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3-isopropylphenyl]fluorene,  
 25 9,9-bis[4-(2-hydroxyethoxy)-3,5-diisopropylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3-n-butylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3,5-di-n-butylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3-isobutylphenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3,5-diisobutylphenyl]fluorene,  
 30 9,9-bis[4-(2-hydroxyethoxy)-3-(1-methylpropyl)phenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3,5-bis(1-methylpropyl)phenyl]fluorene,  
 9,9-bis[4-(2-hydroxyethoxy)-3-phenylphenyl]fluorene,  
 35 9,9-bis[4-(2-hydroxyethoxy)-3,5-diphenylphenyl]fluorene,

9,9-bis[4-(2-hydroxyethoxy)-3-benzylphenyl]fluorene,  
9,9-bis[4-(2-hydroxyethoxy)-3,5-dibenzylphenyl]fluorene,  
9,9-bis[4-(3-hydroxypropoxy)phenyl]fluorene, and  
9,9-bis[4-(4-hydroxybutoxy)phenyl]fluorene, and these  
5 compounds may be used alone or in combination of two or more  
species. Among these,  
9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene and  
9,9-bis[4-(2-hydroxyethoxy-3-methyl)phenyl]fluorene are most  
preferable from the viewpoint of the optical properties and the  
10 moldability.

The 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene is  
obtained, for example, by adding ethylene oxide (hereinafter,  
abbreviated as EO) to 9,9-bis(4-hydroxyphenyl)fluorene. In  
this addition, impurities such as three EO adduct and four EO  
15 adduct, in which several ethylene oxide molecules are excessively  
added to each of both hydroxyl groups of phenol, may be included  
in addition to two EO adduct  
(9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene,) in which an  
ethylene oxide molecule is added to both hydroxyl groups,  
20 respectively. In order to improve the heat resistance of the  
polyester polymer, the purity of the two EO adduct is preferably  
95% or more and more preferably 97% or more.

Another method of obtaining  
9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene includes a method  
25 by adding phenoxy ethanol directly to fluorenone. In this case,  
an adduct formed by adding EO excessively is hard to be contained,  
and the 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene can be more  
suitably used.

In order to produce the polyester polymer of the present  
30 invention by transesterification of a melt-polymerization  
process, a ratio of the dihydroxyl compound expressed by the  
formula (1) is preferably 10 to 95 mol% of a glycol ingredient  
in a resin. When this ratio is 95 mol% or lower, there is an  
advantage that a melt-polymerization reaction is readily to  
35 proceed and a polymerization time is short. In addition, when

it is larger than 95 mol%, the polymerization can be performed in short time by producing the polymer by a solution polymerization process or an interfacial polymerization process. And, the ratio of 10 mol% or higher is preferred in that a glass 5 transition point of a resin is high.

And, if an acid containing sulfur (for example, sulfuric acid, p-toluenesulfonic acid) exists, resulting from a raw material used, diethylene glycol becomes apt to be produced. When an amount of diethylene glycol in a polymer exceeds 6 mol%, 10 a reduction in the glass transition point, an indicator of heat resistance, or a reduction in the refractive index becomes large, a change in the polymer properties increases, and it become difficult to economically provide a polymer of industrially stable quality.

15 The amount of diethylene glycol is preferably 4 mol% or less and particularly preferably 3 mol% or less.

As the polycarbonate used in the present invention, aromatic polycarbonate is particularly suitable. As a polymerization method of polycarbonate, a method of reacting 20 a dihydroxyl compound with phosgene in the presence of an acid binder (solution polymerization process) and a method of reacting a carbonate ester with a dihydroxyl compound by ester interchange (transesterification) are preferably employed. Of these methods, the transesterification is favorable. In the 25 transesterification, its polymerization aspect and form are not particularly limited. For example, any method of a melt-polymerization method and a solid-state polymerization may be employed, but the melt-polymerization method is industrially desirable.

30 As an aromatic dihydroxyl compound, there are exemplified, specifically, bis(4-hydroxyaryl)alkanes such as bis(4-hydroxyphenyl)methane, 2,2-bis(4-hydroxyphenyl)propane, 2,2-bis(4-hydroxy-3-methylphenyl)propane, 35 bis(4-hydroxyphenyl)methane,

1,1-bis(4-hydroxyphenyl)-1-phenylethane,  
4,4'-[1,3-phenylenebis(1-methylethylidene)]bisphenol,  
4,4'-[1,4-phenylenebis(1-methylethylidene)]bisphenol,  
9,9-bis(4-hydroxyphenyl)fluorene,  
5 9,9-bis(4-hydroxy-3-methylphenyl)fluorene, and  
9,9-bis(4-hydroxy-3,5-dimethylphenyl)fluorene;  
bis(hydroxyaryl)cycloalkanes such as  
1,1-bis(4-hydroxyphenyl)cyclohexane,  
1,1-bis(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane,  
10 4-[1-[3-(4-hydroxyphenyl)-4-methylcyclohexyl]-1-methylethyl]-phenol,  
4,4'-[1-methyl-4-(1-methylethyl)-1,3-cyclohexanediyl]bisphenol, and  
2,2,2',2'-tetrahydro-3,3,3',3'-tetramethyl-1,1'-spirobis-[1  
15 H-indene]-6,6'-diol; dihydroxyaryl ethers such as  
bis(4-hydroxyphenyl)ether, and  
4,4'-dihydroxy-3,3'-dimethylphenyl ether; dihydroxydiaryl sulfides such as 4,4'-dihydroxydiphenyl sulfide, and  
4,4'-dihydroxy-3,3'-dimethyldiphenylsulfide;  
20 dihydroxydiaryl sulfoxides such as 4,4'-dihydroxydiphenyl sulfoxide, and  
4,4'-dihydroxy-3,3'-dimethyldiphenylsulfoxide;  
dihydroxydiaryl sulfones such as 4,4'-dihydroxydiphenyl sulfone and 4,4'-dihydroxy-3,3'-dimethyldiphenyl sulfone;  
25 dihydroxydiaryl isatines such as  
4,4'-dihydroxydiphenyl-3,3'-isatine; dihydroxydiaryl xanthenes such as 3,6-dihydroxy-9,9-dimethylxanthene; and  
dihydroxybenzenes such as resorcin, hydroquinone,  
2-tert-butylhydroquinone, 2-phenylhydroquinone,  
30 2-cumylhydroquinone, and 4,4-dihydroxydiphenyl.

Among others, 2,2-bis(4-hydroxyphenyl)propane is given as a preferable aromatic dihydroxyl compound from the viewpoint of the stability as a monomer and the availability of a substance containing less impurities.

35 And, as other aromatic dihydroxyl compounds, there may

be used, for example, one or more species selected from bisphenols such as bis(4-hydroxyphenyl)methane, 1,1-bis(4-hydroxyphenyl)ethane, 1,1-bis(4-hydroxyphenyl)propane, 5 2,2-bis(4-hydroxyphenyl)butane, 2,2-bis(4-hydroxyphenyl)pentane, 2,2-bis(4-hydroxyphenyl)isopentane, 2,2-bis(4-hydroxyphenyl)hexane, 2,2-bis(4-hydroxyphenyl)isohexane, 10 4,4'-dihydroxytriphenylmethane, 4,4'-dihydroxytetraphenylmethane, 1,1-bis(4-hydroxyphenyl)cyclohexane, 2,2-bis(4-hydroxy-3-methylphenyl)propane, 2,2-bis(4'-hydroxy-3',5'-dimethylphenyl)propane, 15 dihydroxydiphenyl ether, dihydroxydiphenyl sulfone and dihydroxydiphenyl sulfide; and dihydric phenolic compounds such as hydroquinone, resorcin, o-methylresorcin and o-cumylresorcin.

As polycarbonate, an aromatic polycarbonate which is 20 obtained, for example, by interfacial polymerization of 2,2-bis(4-hydroxyphenyl)propane with phosgene in an alkaline aqueous solution-methylene chloride system, is suitably used.

And, the resin composition of the present invention may be mixed with a thermal stabilizer in order to inhibit a 25 transesterification reaction of a polyester polymer (first component) with polycarbonate (second component) or to prevent reduction in molecular weight or the deterioration of color tone at the time of molding.

Examples of such a thermal stabilizer include phosphorous 30 acid, phosphoric acid, phosphonous acid, phosphonic acid and esters thereof, and specifically include triphenyl phosphite, tris(nonylphenyl) phosphite, tris(2,4-di-tert-butylphenyl) phosphite, tridecylphosphite, trioctylphosphite, trioctadecylphosphite, 35 didecylmonophenylphosphite, dioctylmonophenylphosphite,

diisopropylmonophenylphosphite, monobutyldiphenylphosphite, monodecyldiphenylphosphite, monooctyldiphenylphosphite, bis(2,6-di-tert-butyl-4-methylphenyl)pentaerythritoldiphosphite,

5 2,2-methylenebis(4,6-di-tert-butylphenyl)octylphosphite, bis(nonylphenyl)pentaerythritoldiphosphite, bis(2,4-di-tert-butylphenyl)pentaerythritoldiphosphite, distearyl pentaerythritoldiphosphite, tributyl phosphate, triethyl phosphate, trimethyl phosphate, triphenyl phosphate,

10 diphenylmonoorthoxenyl phosphate, dibutyl phosphate, dioctyl phosphate, diisopropyl phosphate, tetrakis(2,4-di-tert-butylphenyl) 4,4'-biphenylenediphosphinate, dimethyl benzenephosphonate, diethyl benzenephosphonate, and dipropyl benzenephosphonate.

15 Among others, tris(nonylphenyl)phosphite, trimethylphosphate, tris(2,4-di-tert-butylphenyl)phosphite, bis(2,4-di-tert-butylphenyl)pentaerythritoldiphosphite, and dimethyl benzenephosphonate are preferably employed.

These thermal stabilizers may be used alone or in

20 combination of two or more species. An amount of such a thermal stabilizer to be mixed is preferably 0.0001 to 1 parts by weight, more preferably 0.0005 to 0.5 parts by weight, and furthermore preferably 0.001 to 0.2 parts by weight with respect to 100 parts by weight of the total amount of the polyester polymer (first

25 component) and the polycarbonate (second component).

And, the resin composition of the present invention may be mixed with a usually known antioxidant for the purpose of preventing oxidation. Examples of such an antioxidant include pentaerythritol tetrakis(3-mercaptopropionate),

30 pentaerythritol tetrakis(3-laurylthiopropionate), glycerol-3-stearylthiopropionate, triethyleneglycol-bis[3-(3-tert-butyl-5-methyl-4-hydroxyphenyl)propionate],

35 1,6-hexanediol-bis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate], pentaerythritol

tetrakis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate], octadecyl-3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate, 1,3,5-trimethyl-2,4,6-tris(3,5-di-tert-butyl-4-hydroxybenzyl)benzene,

5 N,N-hexamethylenebis(3,5-di-tert-butyl-4-hydroxy-hydrocynamide), 3,5-di-tert-butyl-4-hydroxy-benzylphosphonate-diethyl ester, tris(3,5-di-tert-butyl-4-hydroxybenzyl)isocyanurate, 4,4'-biphenylenediphosphinic acid

tetrakis(2,4-di-tert-butylphenyl), and

10 3,9-bis{1,1-dimethyl-2-[ $\beta$ -(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy]ethyl}-2,4,8,10-tetraoxaspiro(5,5)undecane.

Amounts of these antioxidants to be mixed is preferably 0.0001 to 0.5 parts by weight with respect to 100 parts by weight 15 of the total amount of the polyester polymer (first component) and the polycarbonate (second component).

And, the resin composition of the present invention may be mixed with a release agent, within the bounds of not impairing the object of the present invention, in order to improve a 20 releasing property from a die at the time of melt molding more. Examples of such a release agent include a higher fatty acid ester of a monohydric or a polyhydric alcohol, a higher fatty acid, paraffin wax, beeswax, olefin wax, olefin wax containing a carboxyl group and/or a carboxylic anhydride group, silicone 25 oil, and organopolysiloxane. An amount of such a release agent to be mixed is preferably 0.01 to 5 parts by weight with respect to 100 parts by weight of the total amount of the polyester polymer (first component) and the polycarbonate (second component).

30 As the higher fatty acid ester, partial ester or total ester of a monohydric or a polyhydric alcohol having 1 to 20 carbon atoms and a saturated fatty acid having 10 to 30 carbon atoms is preferred. Examples of such the partial esters or total esters of a monohydric or a polyhydric alcohol and a saturated 35 fatty acid include monoglyceride stearate, diglyceride stearate,

triglyceride stearate, monosorbitate stearate, stearyl stearate, monoglyceride behenate, behenyl behenate, pentaerythritol monostearate, pentaerythritol tetrastearate, pentaerythritol tetrapelargonate, propylene glycol 5 monostearate, stearyl stearate, palmityl palmitate, butyl stearate, methyl laurate, isopropyl palmitate, biphenyl biphenate, sorbitan monostearate, and 2-ethylhexyl stearate.

Among others, monoglyceride stearate, triglyceride stearate, pentaerythritol tetrastearate, and behenyl behenate 10 are preferably used.

As the higher fatty acid in the present invention, saturated fatty acids having 10 to 30 carbon atoms are preferred. Examples of such a fatty acid include myristic acid, lauric acid, palmitic acid, stearic acid, and behenic acid.

15 These release agents may be used alone or in combination of two or more species. Metallic soap such as calcium stearate and zinc stearate improves a releasing property but causes much turbidity, and therefore it is unsuitable for the resin composition of the present invention.

20 The thermoplastic resin composition of the present invention may be mixed with a light stabilizer within the bounds of not impairing the object of the present invention.

Examples of such a light stabilizer includes 2-(2'-hydroxy-5'-tert-octylphenyl)benzotriazole, 25 2-(3-tert-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole, 2-(5-methyl-2-hydroxyphenyl)benzotriazole, 2-[2-hydroxy-3,5-bis( $\alpha$ , $\alpha$ -dimethylbenzyl)phenyl]-2H-benzotriazole, 2,2'-methylenebis(4-cumyl-6-benzotriazolephenyl), and 2,2'-p-phenylenebis(1,3-benzoxazine-4-one). An amount 30 of such a light stabilizer to be mixed is preferably 0.01 to 2 parts by weight with respect to 100 parts by weight of the total amount of the polyester polymer (second component) and the polycarbonate (second component). These light stabilizers may be used alone or in combination of two or more species.

35 A blueing agent may be mixed in the resin composition of

the present invention in order to cancel out a yellowish tone of the lenses attributed to the polyester polymer, the polycarbonate or an ultraviolet absorber, in molding a resin into a lens. Any blueing agent can be used without any particular 5 obstacles as long as it is one used for the polyester polymer or the polycarbonate resin.

Generally, anthraquinone type dye is easily available and preferred. Examples of specific blueing agents include a general name Solvent Violet 13 (CA. No (color index No) 60725), 10 a general name Solvent Violet 31 (CA. No 68210), a general name Solvent Violet 33 (CA. No 60725), a general name Solvent Blue 94 (CA. No 61500), a general name Solvent Violet 36 (CA. No 68210), a general name Solvent Blue 97 and a general name Solvent Blue 45 (CA. No 61110), as a representative one.

15 These blueing agents are usually mixed in the proportion of  $0.1 \times 10^{-4}$  to  $2 \times 10^{-4}$  parts by weight with respect to 100 parts by weight of the total amount of the polyester polymer (second component) and the polycarbonate (second component).

20 As a method of blending the polyester polymer (first component) with the polycarbonate (second component) of the present invention, an arbitrary method is employed. There are, for example, a method of mixing with a tumbler, a V-type blender, a super mixer, a Nautermixer, a Banbury mixer, a kneading roller and an extruder, and a solution blending method of mixing the 25 above two components with these components dissolved in a common good solvent such as methylene chloride, but this method is not particularly limited to these methods and any method may be employed as long as it is a polymer blending method usually used.

30 The resin composition thus obtained can be molded into a shaped substance by usually known methods such as an injection molding process, an extrusion molding process and a compression molding process as-is or after pelletizing the resin composition once with an melt extruder.

35 The resin composition of the present invention preferably gives a single glass transition point in conducting measurement

by differential scanning calorimetry (DSC). Generally, resin compositions may give two peaks corresponding to the polyester polymer (first component) and the aromatic polycarbonate (second component), and other peaks or shoulders, but most of them have 5 low transparency, thermal instability and poor moldability and hardly become a good optical material.

Preferably, a uniaxial extruder or a biaxial extruder may be used in melt extruding in order to enhance the miscibility of the thermoplastic resin composition of the present invention 10 to attain a stable releasing property and various physical properties.

A method of using the uniaxial extruder or the biaxial extruder can be favorably employed because a solvent is not used, a burden on an environment is small and productivity is high. 15 A temperature of melt kneading of the extruder is 200 to 350°C and preferably 230 to 300°C. When this temperature is lower than 200°C, since the melt viscosity of the resin is high, a load on the extruder becomes large and productivity is reduced. When it is higher than 350°C, the resin tends to be easily 20 deteriorated and becomes yellowish, and the strength of the resin is lowered because of decreasing the molecular weight of resin. And, a thermal stabilizer, an antioxidant, a release agent and a light stabilizer may be simultaneously kneaded as required.

When an extruder is used, it is desirable to install a 25 filter in order to prevent contaminants such as burn of resin and foreign matter in extruding. A size of filter eliminating the foreign matter depends on an optical precision required, and a filter capable of filtering out the foreign matter up to a size not more than 100  $\mu\text{m}$  is preferred. When the mixing of 30 the foreign matter is particularly avoided, a filter capable of filtering out up to a size not more than 40  $\mu\text{m}$  and further not more than 10  $\mu\text{m}$  is preferred.

A resin extruded from an extruder is preferably processed 35 in a clean room in order to prevent the mixing of the foreign matter after extrusion.

And, as the extruded resin is cooled and palletized, it is preferred to use a cooling method such as air-cooling and water-cooling. When air-cooling is employed, it is desired to use air in which the foreign matter is eliminated with a HEPA (high efficiency particle air) filter in advance, and to prevent the re-attachment of the foreign matter in air. When water-cooling is employed, it is desired to use water in which a metal content is eliminated with an ion-exchange resin and further the foreign matter in water is eliminated with a filter.

10 There are filters of various sizes, and filters of 10 to 0.45  $\mu\text{m}$  are preferably used.

As for a polymerization degree of the polyester polymer, a polyester polymer (first component) having a polymerization degree corresponding to 0.3 to 0.8 of an intrinsic viscosity (measured at 20°C in a mixed solution of 60% by weight of phenol and 40% by weight of 1,1,2,2-tetrachloroethane) is preferred. A substance having the extremely low intrinsic viscosity has the low mechanical strength at the time of being molded into a lens or the like. And, when the intrinsic viscosity becomes large, fluidity during molding is reduced and a cycle characteristic is deteriorated, and therefore the birefringence of a shaped article tends to be apt to become large. Therefore, as the polyester polymer (first component), a polyester polymer having a polymerization degree corresponding to 0.3 to 0.8 of an intrinsic viscosity is employed, and furthermore preferably, a polyester polymer having a polymerization degree corresponding to 0.35 to 0.7 of an intrinsic viscosity is employed.

As for a polymerization degree of the polycarbonate, aromatic polycarbonate having a polymerization degree corresponding to 0.2 to 0.7 of an intrinsic viscosity is preferred. A substance having the extremely low intrinsic viscosity has the insufficient mechanical strength at the time of being molded into a lens. And, when the intrinsic viscosity becomes large, fluidity during molding is reduced, and molecular orientation is apt to occur and the birefringence of an injection molded

polymer tends to become large. Therefore, as the aromatic polycarbonate, aromatic polycarbonate having a polymerization degree corresponding to 0.2 to 0.7 of an intrinsic viscosity is employed, and furthermore preferably, aromatic polycarbonate 5 having a polymerization degree corresponding to 0.3 to 0.55 of an intrinsic viscosity is employed.

A glass transition point of the resin composition of the present invention is 100°C or higher, preferably is 120°C or higher, and furthermore preferably is 130°C or higher. When 10 the glass transition point is 100°C or higher, it is preferred since the deformation under the high temperature and high humidity conditions hardly occur and variations in the figure tolerance of a lens are low.

The resin composition for optical materials of the present 15 invention is formed by mixing uniformly two components having the respective polymerization degrees described above, but it is preferred to select a blending ratio of the polyester polymer (first component) and the aromatic polycarbonate (second component) within a range of 5 : 95 to 95 : 5 by weight. When 20 the blending ratio is within this range, it is preferred since a remarkable effect of reducing the birefringence is attained. Further, it is preferred to select the blending ratio within a range of 20 : 80 to 80 : 20 by weight.

In the present invention, when the solution polymerization 25 process or the interfacial polymerization process is used in producing the polyester polymer (first component), generally, acid chloride is used as an active species of an acid component, and methylene chloride or chloroform is used as a solvent, but since an chloride of a byproduct and catalytic compounds remain 30 in a polymer and these substances have a detrimental effect on the product quality, the residual foreign matter has to be generally removed after the polymerization step. These substances cause the operability in the molding steps of sheet, film, plate and fiber to deteriorate and even the quality of 35 a shaped body to be obtained to deteriorate. For example, thermal

degradation occurs much in heating the shaped body to elevated temperatures.

And, when the resin composition of the present invention is used as an optical material of an optical disk or a magnet optical disk, a metallic thin film such as a reflective film and a recording film is deposited on a substrate by a technique such as vapor deposition, sputtering or the like, but when a residual chlorine content exists within the substrate, a step of removing the residual chlorine, such as adequate cleaning or adequate filtering, is required since the residual chlorine erodes the reflective film and the recording film and causes the life and the reliability of the optical disk or the magnet optical disk to decrease. As a polymerization method of the polyester polymer (first component), transesterification in which there is no contamination of chlorine is more preferable.

An injection compression molding machine is usually well suited for molding an optical disk substrate, and in this molding, a surface temperature of a die and a temperature of a resin are particularly important as a molding condition. The molding conditions cannot be defined since they vary with a blending ratio, composition and a polymerization degree of the polyester polymer (first component) and the polycarbonate (second component), but the surface temperature of a die is preferably at least 50°C and at most 160°C, and it is desired to adjust the resin temperature at this surface temperature of a die so as to be at least 220°C and at most 330°C. When the surface temperature of a die is 50°C or lower, both the fluidity and the transfer of the resin are poor, and therefore stress-strain remains in injection molding and the birefringence tends to increase, and further it is not economical since a molding cycle is extended. When the surface temperature of a die is 160°C or higher, though the transfer of the resin is good, the resin tends to deform at the time of releasing. And, when the resin temperature is 330°C or higher, the degradation of the resin is apt to occur, resulting in a reduction in strength of a shaped

article and coloring of a shaped article.

When the optical material is molded from the resin composition for optical materials of the present invention, it is desired to do it, being careful not to immix dust or the like 5 in the steps of from charging a raw material through a polymerization reaction to extruding a copolymer into a cooling medium as shaped article in pellet or sheet form. Cleanliness for this molding is generally 1000 or less for molding of compact disks and 100 or less for molding of information recording media

10 Injection molding or injection compression molding is generally used for molding a lens. In this molding, a surface temperature of a die and a temperature of a resin are particularly important as a molding condition. The molding conditions cannot be defined since they vary with a blending ratio, composition 15 and a polymerization degree of the polyester polymer (first component) and the polycarbonate (second component), but the surface temperature of a die is preferably at least 50°C and at most 160°C, and it is desired to adjust the resin temperature at this surface temperature of a die so as to be at least 220°C 20 and at most 330°C. When the surface temperature of a die is 50°C or lower, both the fluidity and the transfer of the resin are poor, and therefore stress-strain remains in injection molding and the birefringence tends to increase, and lens performance required may not be satisfied. When the temperature 25 of a die is 160°C or higher, the resin tends to deform at the time of releasing. And, when the resin temperature is 220 or lower, it is not preferred since the fluidity of the resin is poor and excessive load may be exerted on a molding machine. When the resin temperature is 330°C or higher, the degradation 30 of the resin is apt to occur, resulting in a reduction in strength of a shaped article and coloring of a shaped article.

When a lens is molded, it is necessary to finish the surface shape of a lens precisely and reduce birefringence-causing internal residual stress as far as possible in order to secure 35 lens performance. Though a balance with a molding cycle have

to be considered, it is often to mold a resin with a die temperature raised as far as possible and a cooling time lengthened. When the die temperature approaches a glass transition point  $T_g$ , a mold shrinkage may become small and therefore a releasing 5 property from a die may be deteriorated. In such a case, it is more preferred to use a resin composition in which the above-mentioned release agent is mixed.

Hereinafter, the present invention will be described by way of examples.

10

#### EXAMPLES

##### (1) Refractive index and Abbe number

An Abbe refractometer DR-M2 manufactured by ATAGO CO., LTD. was used, and a refractive index  $n_d$  in a D-line was measured 15 using an interference filter of a wavelength of 589 nm, a refractive index  $n_c$  in a C-line using an interference filter of a wavelength of 639 nm, and a refractive index  $n_F$  in a F-line using an interference filter of a wavelength of 486 nm. An Abbe number  $v_d$  was calculated from the formula:  $(1 - n_d) / (n_c - n_F)$ . 20 A test sample for measurement was prepared by forming a resin by pressing at a temperature of 160 to 240°C to prepare a film having a thickness of 80 to 150  $\mu\text{m}$  and cutting the obtained film into a rectangular piece of a size of about 8×20 mm. A refractive index and an Abbe number of the test sample were measured at 25 20°C using 1-bromonaphthalene as an interfacial solution.

##### (2) Glass transition point ( $T_g$ )

Using a differential scanning calorimeter (DSC-110 manufactured by Seiko Instruments Inc.), about 10 mg of sample was heated at a temperature raising rate of 10°C/min and measured. 30 A glass transition point  $T_g$  was determined according to JIS K 7121 (1987).

##### (3) Molecular weight

G-6000, G-4000 and G-3000 produced by TOSOH CORPORATION as a column were connected in series. Using a reference standard 35 of polystyrene, a calibration curve was prepared at a flow rate

of 1 ml/min at 40°C using chloroform as an eluant and a UV detector as a detector. From this calibration curve, a weight-average molecular weight on the polystyrene equivalent basis was determined.

5 (4) Light transmittance

The light transmittance of a shaped article of a flat plate having a size of 30 mm × 30 mm × 3 mm, which was molded with an injection molding machine (manufactured by Sumitomo Heavy Industries, Ltd., MINIMAT 14/7B) with a die temperature set at 10 Tg-20°C, was measured using a spectrophotometer (UV-3101PC manufactured by SHIMADZU CORPORATION).

(5) Melt flow rate (MFR)

A melt flow rate was measured under the conditions of orifice diameter 2 mm, temperature 230°C and load 2160 g according 15 to JIS K 7210.

(6) Birefringence

By using a polarizing microscope manufactured by Carl Zeiss AG, the birefringence was measure with monochromatic light with Serarmont, Berek, and Brace-Keller compensators fitted to the 20 polarizing microscope.

(6-1) Evaluation on film

A resin was melted at a temperature of 260 to 300°C, and a test sample in the form of a disk of 30 mm in diameter and 1 mm in thickness was prepared by extruding, and further the 25 test sample extruded was formed by pressing at a temperature of 160 to 240°C to prepare a film having a thickness of 80 to 150 µm. The obtained film was cut into a rectangular piece of a size of 4×40 mm to obtain a test sample for measurement. The test sample for measurement was drawn by 40% at a rate of 20 %/sec 30 at a temperature of a glass transition point (Tg)+10°C and then rapidly cooled to obtain a drawn film. A birefringence was measured on each of these films.

(6-2) Evaluation on shaped article

After obtaining a shaped article of a flat plate having 35 a size of 30 mm × 30 mm × 3 mm, which was molded using an injection

molding machine (manufactured by Sumitomo Heavy Industries, Ltd., MINIMAT 14/7B) at a die temperature of Tg-20°C, the shaped article was annealed at a temperature of Tg-20°C for 3 hours, and the retardation of its center portion was measured.

5 (7) Intrinsic viscosity

a copolymer 0.15 to 0.5 g was dissolved in 50 ml of a mixed solution of phenol of 60% by weight and 1,1,2,2-tetrachloroethane of 40% by weight at 80°C and then the viscosity of the solution was measured at 20°C to determine the intrinsic viscosity.

10 (8) Impact resistant property

Izot impact strength was measured according to JIS K 7110

(9) Determination of diethylene glycol (hereinafter, abbreviated as DEG)

Preparation of sample

15 Into a 200 ml flask with ground stopper, 50 ml of 1-propanol was placed and 2.81 g of potassium hydroxide and 2 g of resin pellets precisely weighed were placed. Then, a bulb Allihn condenser cooled with water was attached, and the content of the flask was heated and refluxed for 2 hours while stirring.

20 After cooling, 10 ml of water and 7 g of terephthalic acid were added, and the mixture was heated and refluxed for 1 hour. 5 ml of a 1% 1-propanol solution of tetraethylene glycol dimethyl ether was added as an internal reference and the mixture was stirred for about 5 minutes. A sample was filtered and quantified

25 by a gas chromatograph to determine the content of diethylene glycol.

(10) Pressure Cooker Test

A shaped article was tested under the conditions of temperature 105°C, humidity 100% and 24 hours using Highly Accelerated Stress Test System (manufactured by Tabai Espec Corporation, TPC-212M).

An appearance of the shaped article after the test was observed and the light transmittance was measured with a spectrophotometer (UV-3101PC manufactured by SHIMADZU CORPORATION).

## [Example 1]

Using 1,4-cyclohexanedicarboxylic acid, and 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene in an amount of 0.8 5 mol and ethylene glycol in an amount of 2.2 mol per 1 mol of 1,4-cyclohexanedicarboxylic acid as a raw material, these compounds were charged into a reaction vessel, and vessel contents was gradually heated from room temperature to 230°C according to a normal method while stirring to perform an 10 esterification reaction. After drawing a predetermined amount of water out of a system, germanium oxide, a polymerization catalyst, in an amount of 0.002 mol and phosphoric acid trimethyl ester in an amount of 0.0014 mol for preventing coloring were charged into the vessel. Temperature raising and pressure 15 reducing were gradually conducted while drawing ethylene glycol generated until a temperature of a heating vessel reached 270°C and a degree of vacuum reached 133 Pa (1 Torr) or lower. These conditions were held during viscosity and agitating torque increased, and after reaching a specified agitating torque (after 20 a lapse of about four hours), the reaction was completed and a reaction product was extruded into water to obtain a pellet.

This resin was pressed at 200°C to obtain a film of about 100 µm in thickness. The refractive index of the film was 1.607, a glass transition point was 126°C and the content of DEG was 25 1.8 mol%.

This polyester resin (first component) and polycarbonate (second component: produced by Teijin Chemicals Ltd., Panlite L1250) were charged into a biaxial extruder (TEM35B manufactured by TOSHIBA MACHINE CO., LTD.) installed in a clean room in the 30 weight proportions of 50:50, and bis(2,4-di-tert-butylphenyl)pentaerythritoldiphosphite as a thermal stabilizer was added in an amount of 0.1 parts by weight with respect to 100 parts by weight of the total of the polyester resin and the polycarbonate, and the resulting mixture was 35 kneaded and then a resin extruded was cooled in a water tank

filled with water pass through a filter of 1  $\mu\text{m}$  and cut sequentially with a cutter to obtain a pellet. In this operation, a temperature of resin at the outlet of a discharge mouthpiece was 280°C.

5 The resulting resin pellet was pressed at 200°C to obtain a film of about 100  $\mu\text{m}$  in thickness. The refractive index of the film was 1.595, an Abbe number was 29, and a glass transition point was 132°C.

10 A shaped article, into which the obtained resin pellet was molded with an injection molding machine, was uniform and clear. The results are shown in Table 1.

[Examples 2 to 5]

15 Each pellet was prepared by following the same procedure as in Example 1 except that the composition of a polyester polymer (first component) and polycarbonate (second component) was changed as shown in Table 1, and evaluated similarly. The results of evaluations are shown in Table 1. In any example, a uniform and clear shaped article was obtained and the moldability was 20 good.

[Example 6]

Using 2,6-decalindicarboxylic acid dimethyl ester, and 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene in an amount of 25 0.55 mol and ethylene glycol in an amount of 2.2 mol per 1 mol of 2,6-decalindicarboxylic acid dimethyl ester as a raw material, and calcium acetate in an amount of 0.0008 mol and manganese acetate in an amount of 0.0002 mol per 1 mol of 30 2,6-decalindicarboxylic acid dimethyl ester as a catalyst, these compounds were charged into a reaction vessel, and the contents of the vessel was gradually heated from room temperature to 230°C according to a normal method while stirring to perform an transesterification reaction. After drawing a predetermined amount of methanol out of a system, germanium oxide, a 35 polymerization catalyst, in an amount of 0.012 mol and phosphoric

acid trimethyl ester in an amount of 0.0018 mol for preventing coloring were charged into the vessel. Temperature raising and pressure reducing were gradually conducted while drawing ethylene glycol generated until a temperature of a heating vessel  
5 reached 270°C and a degree of vacuum reached 133 Pa (1 Torr) or lower. These conditions were held during viscosity and agitating torque increased, and after reaching a specified agitating torque (after a lapse of about two hours), the reaction was completed and a reaction product was extruded into water  
10 to obtain a pellet.

The glass transition point of the pellet was 123°C, a refractive index was 1.584 and the content of DEG was 2.3 mol%.

This polyester resin (first component) and polycarbonate (second component: produced by Teijin Chemicals Ltd., Panlite  
15 L1250) were charged into a biaxial extruder (TEM35B manufactured by TOSHIBA MACHINE CO., LTD.) installed in a clean room in the weight proportions of 50:50, and  
bis(2,4-di-tert-butylphenyl)pentaerythritoldiphosphite as a thermal stabilizer was added in an amount of 0.1 parts by weight  
20 with respect to 100 parts by weight of the total of the polyester resin and the polycarbonate, and the resulting mixture was kneaded and then a resin extruded was cooled in a water tank filled with water pass through a filter of 1  $\mu$ m and cut sequentially with a cutter to obtain a pellet. In this operation, a  
25 temperature of resin at the outlet of a discharge mouthpiece was 280°C.

The resulting resin pellet was pressed at 200°C to obtain a film of about 100  $\mu$ m in thickness. The refractive index of the film was 1.584, an Abbe number was 31, and a glass transition  
30 point was 130°C.

A shaped article, into which the obtained resin pellet was molded with an injection molding machine, was uniform and clear. The results are shown in Table 1.

35 [Example 7]

The polyester resin (first component) obtained in Example 1 and polycarbonate (second component: produced by Teijin Chemicals Ltd., Panlite L1250) were mixed in the weight proportions of 50:50, and then

5 bis(2,4-di-tert-butylphenyl)pentaerythritoldiphosphite as a thermal stabilizer was added to this mixed resin in an amount of 0.05 parts by weight with respect to 100 parts by weight of the total of the polyester resin and the polycarbonate, and stearic acid as a release agent was added in an amount of 0.4  
10 parts by weight similarly, and a mixture was mixed. The mixed resin and additives were charged in a quantitative manner into a biaxial extruder (TEM25B manufactured by TOSHIBA MACHINE CO., LTD.), located in a clean room and equipped with a filter of 30  $\mu\text{m}$ , to be kneaded, and then a resin extruded was cooled in  
15 a water tank filled with water pass through a filter of 1  $\mu\text{m}$  and cut sequentially with a cutter to obtain a pellet. In this operation, a temperature of resin at the outlet of a discharge mouthpiece was 280°C.

The resulting resin pellet was pressed at 200°C to obtain  
20 a film of about 100  $\mu\text{m}$  in thickness. The refractive index of the film was 1.595, an Abbe number was 29, and a glass transition point was 131°C.

The results are shown in Table 1. A shaped article exhibits uniform and clear. Even though a die temperature was set at  
25 a temperature close to  $T_g$  (of the order of  $T_g-10^\circ\text{C}$ ), the moldability was good and a releasing property was also good.

Table 1

	Composition of first component		Composition in kneading		Glass transition point (°C)	MRF g/10min	Impact strength	Refractive index nd	Abbe number	Light Transmittance 3mm%			Birefringence $\times 10^{-4}$	Retardation nm
	acid	dihydroxy compound	parts by weight of first component	parts by weight of second component						700nm	500nm	400nm		
Example 1	A	80	50	50	132	4	3.4	1.595	29	89.2	87.2	82.3	46	70
Example 2	A	80	30	70	136	3	3.8	1.591	29	89.5	88.0	84.2	70	30
Example 3	A	80	70	30	128	5	3.2	1.600	28	88.3	86.3	80.1	32	120
Example 4	A	80	10	90	126	2	4.5	1.587	29	89.6	88.9	86.1	89	25
Example 5	A	80	90	10	137	7	3	1.604	28	88.0	85.4	78.1	20	180
Example 6	B	55	50	50	130	4	3	1.584	31	89.3	87.4	82.5	51	75
Example 7	A	80	50	50	131	5	3.4	1.595	29	89.2	97.1	82	46	70
Comparative example 1	-	-	0	100	140	1	7	1.585	30	89.9	89.5	88.0	95	200
Comparative example 2	A	80	100	0	140	12	2.9	1.607	27	88.6	85.3	76.5	3	15
Comparative example 3	A	80	50	50	131	5	3.4	-	-	41.6	16.2	4.3	-	-

Dihydroxy compound: 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene

A: 1,4-cyclohexanedicarboxylic acid

B: 2,6-decalindicarboxylic acid dimethyl ester

## Comparative Example 3

A pellet was obtained by following the same procedure as in Example 7 except for changing the release agent from stearic acid to 0.4 parts by weight of calcium stearate. The shaped 5 article exhibited white turbidity and was unsuitable for a lens material using for a visible light region.

The results of Comparative Example 1 show measurement values in the case of using polycarbonate (second component: produced by Teijin Chemicals Ltd., Panlite L1250) singly. The 10 results of Comparative Example 2 show measurement values in the case of using the polyester polymer (first component) described in Example 1 singly.

As is apparent from Table 1, the resin composition of the present invention is found to be a well-balanced resin 15 composition maintaining transparency, heat resistance and impact resistance, in which the polycarbonate and the polyester polymer exert and complement their advantages and disadvantages that polycarbonate has good impact resistance and transparency, but its birefringence is large and a polyester polymer has good 20 fluidity, a high refractive index and low birefringence, but impact resistance, heat resistance and transparency are unsatisfactory.

The results of a pressure cooker test are shown in Table 2. As environmental testing of a lens, the tests under the 25 conditions of temperature 65°C, relative humidity 80% and several hundreds hours or the conditions of temperature 85°C, relative humidity 90% and several hundreds hours are commonly employed, but an accelerated test of the stability under the high temperature and high humidity conditions of temperature 105°C, 30 relative humidity 100% and 24 hours, which were more severe conditions, was carried out. In Examples 1 to 5 and Example 7 of the present invention, a part of resins exhibited a slight white turbidity and decreased in the light transmittance. In the results of Comparative Example 2, namely, the test results 35 of the case of using the polyester polymer (first component)

used in Examples 1 to 5 and Example 7 singly, a white turbidity was large and light rays hardly transmitted. From this result, it is understood that the resin composition of the present invention, which is obtained by blending a polyester polymer with polycarbonate, has improved durability under the high temperature and high humidity conditions.

Table 2

Appearance	Before Pressure Cooker Test						After Pressure Cooker Test		
	Light Transmittance(%) 3mm			Light Transmittance(%) 3mm			Appearance		
	700nm	500nm	400nm	700nm	500nm	400nm	deformation	white turbidity	
Example1	○	89.2	87.2	82.3	81.3	76.5	67.3	○	△~○
Example2	○	89.5	88.0	84.2	87.5	86.0	80.2	○	○
Example3	○	88.3	86.3	80.1	78.6	70.5	59.3	○	△
Example4	○	89.6	88.9	86.1	88.5	87.5	86.0	○	○
Example5	○	88.0	85.4	78.1	50.5	40.3	30.2	○	△
Example6	○	89.3	87.4	82.5	—	—	—	○	○
Example7	○	89.2	97.1	82.0	82.3	77.5	68.3	○	△~○
Comparative example 1	○	89.9	89.5	88.0	89.0	88.0	87.0	○	○
Comparative example 2	○	88.6	85.3	76.5	30.6	19.4	10.2	○	×

Test conditions: temperature 105°C, humidity 100% and 24 hours

deformation: ○: no deformation

white turbidity: ○: no white turbidity; △: slight white turbidity; ×:white turbidity

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## INDUSTRIAL APPLICABILITY

The resin composition of the present invention is suitable for lens applications such as a camera lens, a viewfinder lens and lenses for CCD and CMOS, and for use in films, sheets, and optical materials utilized for a liquid crystal display and a plasma display.